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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/081,916	02/20/2002	Delman Lee	YAMAP0801US	2192

7590 02/03/2005

Neil A. DuChez
Renner, Otto, Boisselle & Sklar
19th Floor
1621 Euclid Avenue
Cleveland, OH 44115

EXAMINER	
STREGE, JOHN B	

ART UNIT	PAPER NUMBER
2625	

DATE MAILED: 02/03/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/081,916	LEE ET AL.	
	Examiner	Art Unit	
	John B Strege	2625	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *20 February 2002*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-42* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,2,6-11,14-17,19-30 and 32-42* is/are rejected.

7)☒ Claim(s) *3-5,12,13,18 and 31* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *20 February 2002* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *4/4/02*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Information Disclosure Statement

The listing of references in the specification is not a proper information disclosure statement. 37 CFR 1.98(b) requires a list of all patents, publications, or other information submitted for consideration by the Office, and MPEP § 609 A(1) states, "the list may not be incorporated into the specification but must be submitted in a separate paper." Therefore, unless the references have been cited by the examiner on form PTO-892, they have not been considered.

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claim 1,6,11,20, and 35-36 are rejected under 35 U.S.C. 102(b) as being anticipated by Papadimitriou et al. *Epipolar Line Estimation and Rectification for Stereo Image Pairs* (from IEEE transactions on Image Processing, April 1996, hereinafter "Papadimitriou").

Papadimitriou discloses a rectification process for a stereo pair of images (page 675, Stage 4-Rectification of Stereo Pair) comprising first and second images capture using first and second image capture devices (figure 1, page 672, first sentence of the introduction). Papadimitriou further discloses determining first and second rectification

transformations for rectifying a respective one of the first and second images so as to reduce vertical disparity (page 675, Stage 4-Rectification of Stereo Pair). As stated in the first sentence of stage 4, the model represented by the $\{a_i, i=0,....,5\}$ guides a transformation process in which the two images of the stereo pair are resampled so that they become vertically aligned. The $\{a_i, i=0,....,5\}$ represent camera parameters that are functions of the focal lengths, the coordinates of the image centers, and the pan angles (page 673, last paragraph of col. 1 – equation (6) of col. 2). Statistics are defined in Webster's dictionary as a collection of quantitative data, thus $\{a_i, i=0,....,5\}$ are read as statistics of the parameters (or a collection of quantitative data of the parameters) of the stereoscopic image capturing device. Therefore Papadimitriou further discloses using statistics of the parameters of the stereoscopic image capture device in the determination of the rectification transformations.

Regarding claim 6, Papadimitriou discloses that the parameters relate to the first and second image capture devices (section II Epipolar Geometry beginning on page 672).

Regarding claim 11, Papadimitriou discloses that the transformation process resamples the images so that they become vertically aligned, thus the statistics of the parameters relate to the alignment (page 675, first sentence of Stage 4-Rectification of Stereo Pair).

Regarding claim 20, as seen in figure 5 Papadimitriou rectifies the stereoscopic pair of images.

Claims 35-36 are similar to the limitations discussed above, thus the same arguments used above apply equally to claims 35-36.

3. Claims 1,14,22-24,33-34,and 39-40 are rejected under 35 U.S.C. 102(b) as being anticipated by IEEE article by Courtney et al. *A Hardware Architecture for Image Rectification and Ground Plane Obstacle Detection* (hereinafter "Courtney")(discussed in the Applicant's prior art on pages 8-9).

Regarding claim 22, as stated by the Applicants on pages 8-9 of the specification, Courtney is one of the systems shown in the prior art system of figure 3(b) involving a rectification system that determines transformations to rectify the images to reduce vertical disparity. Courtney discloses determining rectification transforms to reduce vertical disparity (section 2, page 24) and further states that an image may be transformed so that the epipolars are aligned to rasters in each image in the other to simulate a parallel camera setup (page 23, first paragraph of the introduction).

Regarding claim 23, Courtney discloses that the matrix elements of the transforms may be computed from camera calibration parameters including aspect ratios, focal lengths, etc. (last paragraph of section 2). Statistics are defined in Webster's dictionary as a collection of quantitative data, thus these camera calibration parameters can be read as statistics of the parameters of the image capture device.

Regarding claim 24, the camera calibration parameters are used for the alignment of the images thus they relate to the alignment of the first image capture device relative to the second image capture device.

Claim 24 discloses all of the limitations of claim 1, thus the same arguments used for the rejection of claim 24 apply equally to the rejection of claim 1.

Claim 14 is similar to claim 22, thus the same arguments used for the rejection of claim 22 apply equally to claim 14.

Regarding claim 33, as seen in figure 1 Courtney rectifies the images.

Regarding claim 34, as seen in figure 2 Courtney discloses producing an output stereoscopic image.

Claims 39-40 are similar to the limitations discussed above thus the same arguments used for the above claims apply equally to claims 39-40.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over Papadimitriou et al. *Epipolar Line Estimation and Rectification for Stereo Image Pairs*

(from IEEE transactions on Image Processing, April 1996, hereinafter "Papadimitriou") in view of Zhang et al. USPN 6,608,923 (hereinafter "Zhang").

Papadimitriou does not explicitly disclose that each rectification transformation comprises a horizontal shear and scaling component, and the statistics of the parameters of the image capture deice are in for their determination. Zhang discloses that if the intrinsic parameters of a camera are known, the images are calibrated and the using the fundamental matrix from these parameters the images can be rectified through a transformation process (col. 6 lines 55-65). Furthermore as seen in figure 7 the fundamental matrix 700 is sent to a shearing transform that scales the images in a horizontal direction. The process of Zhang is beneficial in that it is more efficient than the prior art systems and allows for rectifying images with optimally reduced distortion (col. 1 lines 63-67).

Papadimitriou and Zhang are analogous art because they are from the same field of endeavor of rectification of stereoscopic images.

At the time of the invention it would have been obvious to one of ordinary skill in the art to combine Papadimitriou and Zhang to use a horizontal shear and scaling component determined by the statistics of the parameters of the imaging devices. The motivation for doing so is that it would reduce distortion in the system of Papadimitriou. Thus it would have been obvious to one of ordinary skill in the art to combine Papadimitriou and Zhang to obtain the invention as specified in claim 2.

6. Claims 7-10, and 37-38 are rejected under 35 U.S.C. 103(a) as being unpatentable over Papadimitriou et al. *Epipolar Line Estimation and Rectification for Stereo Image Pairs* (from IEEE transactions on Image Processing, April 1996, hereinafter "Papadimitriou").

Claims 7-10 are dependent on claim 6 (rejected above by Papadimitriou). Papadimitriou does not explicitly disclose that the statistics comprise the mean and standard deviation of the focal points, or the mean and standard deviation of the principal points. However the mean and standard deviation are standard well known functions. As stated above Papadimitriou discloses that the parameters are functions of the focal lengths and image centers (page 673, paragraph above equation 6). Thus it would be obvious to one of ordinary skill to use the mean or standard deviation of these parameters as the function of the focal length with the motivation that these could be obtained easily through the preliminary calibration stage.

Regarding claims 37-38, it is well known to use a data processor with a stereoscopic camera thus it would be obvious to use a data processor to carry out the invention.

7. Claim 21 is rejected under 35 U.S.C. 103(a) as being unpatentable over Papadimitriou et al. *Epipolar Line Estimation and Rectification for Stereo Image Pairs* (from IEEE transactions on Image Processing, April 1996, hereinafter "Papadimitriou") in view of the Applicant's admitted prior art.

Regarding claim 21, Papadimitriou does not explicitly disclose displaying the stereoscopic images on a stereoscopic display device, however it is obvious that it is doing so since the purpose of rectifying images is to see them better on a display device.

As seen in figures 3a-3c of the Applicant's admitted prior art step 17 shows displaying the rectified image pair on a stereoscopic imaging device.

Papadimitriou and the Applicant's admitted prior art are analogous art because they are from the same field of endeavor of rectification of stereoscopic images.

At the time of the invention it would have been obvious to one of ordinary skill in the art to combine Papadimitriou and the Applicant's admitted prior art to display the rectified images on a stereoscopic display device with the motivation that one could see the rectification results.

8. Claims 15-17, and 19, 28-30, 32, and 41-42 are rejected under 35 U.S.C. 103(a) as being unpatentable over Courtney et al. *A Hardware Architecture for Image Rectification and Ground Plane Obstacle Detection* (hereinafter "Courtney") in view of Lipton et al. USPN 5,142,357 (hereinafter "Lipton") and further in view of the Applicant's admitted prior art.

Regarding claims 15-16, Courtney does not explicitly disclose whether or not the image is a still image or part of a video image since it is mainly concerned with rectifying the image. However it is well known that a stereoscopic images can be created as still images or part of a video image.

Lipton discloses a stereoscopic camera that can be used for video or still images (as stated at least in the abstract).

Lipton and Courtney are analogous art because they are from the same field of endeavor of stereoscopic imaging.

At the time of the invention it would have been obvious to one of ordinary skill in the art that the invention as disclosed by Courtney could be used for a still stereoscopic image or a video stereoscopic image since both types of existing systems could be improved by rectification. Thus it would have been obvious to one of ordinary skill in the art to combine Lipton and Courtney to obtain the invention as specified in claims 15-16.

Regarding claim 17, Courtney nor Lipton disclose rectifying subsequent frames of the stereoscopic video image using the first and second rectification transformations determined for the first frame of the stereoscopic video image.

In the Applicant's admitted prior art (figures 3a-3c) the Applicant states that once suitable rectifying transformations have been determined from one captured image pair, a subsequent captured image pair acquired using the same camera set-up can be directly warped at step 15 using the rectifying transformations determined earlier (page 8 lines 5-20).

Courtney, Lipton, and the Applicant's admitted prior art are all analogous art because they all deal with stereoscopic cameras.

At the time of the invention it would have been obvious to one of ordinary skill in the art to combine Courtney, Lipton, and the Applicant's admitted prior to rectify

subsequent frames of the stereoscopic video image using the first and second rectifications used for the first frame.

Regarding claim 19, it would be obvious to carry out the rectification of each frame of a video image using the method of Courtney since each frame would need to be rectified to improve the stereoscopic image.

Claim 28 (dependent on claim 22 rejected by Courtney) is similar to claim 15 thus the same arguments applied for claim 15 apply equally to claim 28. The same holds true regarding claim 29 (similar to 16), claim 30 (similar to 17), and claim 32 (similar to claim 19).

Regarding claims 41-42, Lipton discloses a data processor (87 of figure 12).

9. Claims 25-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Courtney et al. *A Hardware Architecture for Image Rectification and Ground Plane Obstacle Detection* (hereinafter "Courtney") in view of Zhang et al. USPN 6,608,923 (hereinafter "Zhang").

As discussed above Courtney discloses the limitations of claim 22. Courtney does not explicitly disclose determining a first and second component of each of the first and second rectification transformations.

As seen in figure 7, Zhang discloses finding a first and second component of each of the first and second rectification transformations, the first being the similarity transform 712, and the second being the shearing transform 714. The process of Zhang is beneficial in that it is more efficient than the prior art systems and allows for rectifying

images with optimally reduced distortion (col. 1 lines 63-67). Similar to Courtney who aligns the epipoles to simulate a parallel camera geometry (first paragraph of the introduction), Zhang is also interested in making the epipolars lines parallel (col. 1 lines 25-37)(thus simulating a parallel camera geometry also).

Courtney and Zhang are analogous art because they are from the same field of endeavor of rectification of stereoscopic images.

At the time of the invention it would have been obvious to one of ordinary skill in the art to combine Courtney and Zhang to use a first component for finding the similarity and thus eliminating disparity and using a second component for shearing to make a virtual parallel camera setup. The motivation for doing so is that it would reduce distortion in the system of Courtney. Thus it would have been obvious to one of ordinary skill in the art to combine Courtney and Zhang to obtain the invention as specified in claim 25.

Regarding claims 26-27, as discussed above Courtney discloses using statistics of the parameters of the stereoscopic image capture device and the parameters relate to the alignment of the cameras.

Allowable Subject Matter

Claims 3-5,12-13,18, and 31 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Ayache et al. *Rectification of Images for Binocular and Trinocular Stereovision* in International Conference of Pattern Recognition, pages 11-16 (1998).

Bing Kang et al. *An active multibaseline stereo system with real-time image acquisition* Tech. Rep. CMU-CS-94-167, School of Computer Science, Carnegie Mellon University (1994)

Contact Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to John B Strege whose telephone number is (703) 305-8679. The examiner can normally be reached on Monday-Friday between the hours of 8-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Bhavesh Mehta can be reached on (703) 308-5246. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

JS

BHAVESH M. MEHTA
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2600